EIGHTH ANNUAL REPORT

OF

Rutgers Scientific School,

FOR

AGRICULTURE AND MECHANIC ARTS.

FOR THE YEAR 1872.

TRENTON, N. J.:
PRINTED AT THE STATE GAZETTE OFFICE.
1872.

EIGHTH ANNUAL REPORT

OF

Rutgers Scientific School,

FOR

AGRICULTURE AND MECHANIC ARTS.

FOR THE YEAR 1872.

TRENTON, N. J.:
THE STATE GAZETTE—MURPHY & BECHTEL, BOOK AND JOB PRINTERS.
1872

BOARD OF VISITORS.

JAMES M. MECUM, . . .	First District.
JONATHAN INGHAM, . . .	" "
WILLIAM HENRY HENDRICKSON, .	Second District.
WILLIAM PARRY	" "
JOSEPH THOMPSON, . . .	Third District.
JAMES BISHOP, ...	" "
JOHN STEELE.	Fourth District.
(Vacancy,)	" "
FRANCIS H. DAWES, ...	Fifth District.

REPORT OF THE TRUSTEES.

To His Excellency Joel Parker, Governor of the State of New Jersey:

SIR:—I beg leave, in behalf of the Trustees of Rutgers College, to submit the eighth annual report of Rutgers Scientific School, in accordance with the requirements of the fourth paragraph of section fifth, of the act of Congress, approved July 2, 1862, and section fifth of the act of the Legislature of the State of New Jersey, approved April 4, 1864.

I. FACULTY OF RUTGERS SCIENTIFIC SCHOOL.

The Faculty is now constituted as follows:

Rev. William Henry Campbell, D. D., LL. D., President, and Professor of Moral Philosophy.

George H. Cook, Ph. D., LL. D., Vice President, and Professor of Chemistry, Natural History and Agriculture.

David Murray, A. M., Ph. D., Professor of Mathematics, Natural Philosophy and Astronomy.

Rev. Theodore S. Doolittle, D. D., Professor of Rhetoric, Logic and Mental Philosophy.

John Conover Smock, A. M., Professor of Mining and Metallurgy.

George W. Atherton, A. M., Voorhees Professor of History, Political Economy and Constitutional Law, and Military Superintendent.

Rev. Carl Meyer, D. D., Professor of French and German.

Francis Cuyler Van Dyck, A. M., Professor of Analytical Chemistry.

Edward A. Bowser, M. S., Professor of Mathematics and Engineering.

Isaac E. Hasbrouck, A. M., Adjunct Professor of Mathematics.

Albert S. Cook, B. S., Tutor in Mathematics.

Since the close of the last academic year, Professors Doolittle and Hasbrouck have been in Europe. Professor Doolittle is expected to return in season to resume his duties near the close of the present term or at the beginning of the next.

Professor Hasbrouck, who has for several years been employed in the Scientific School as a tutor, was, at the last commencement, appointed to an adjunct professorship, and granted leave of absence for

a year, with a view to pursuing special studies in France and Germany.

Mr. Cook was graduated from the Scientific School at the last commencement, and shortly afterwards received his appointment to the position which he now holds.

II. COURSES OF STUDIES AND DEGREES.

The Scientific School provides two principal courses of study, either of which the student may elect for himself.

1. A COURSE IN CIVIL ENGINEERING AND MATHEMATICS.

2. A COURSE IN CHEMISTRY AND AGRICULTURE.

These courses now extend through four years. The studies of the first two years are the same in both, and are so arranged as to meet the wants of young men who desire to become land surveyors, or practical workers in any department of industry, without being able to go through an extended course of preparation.

A special course in chemistry is also provided for students who wish to devote themselves exclusively to that subject. This course extends through two years.

In addition to these regular courses, provision is made for PARTIAL STUDENTS, who may enter at any time, and elect, under the advice and direction of the Faculty, such studies as they may be found qualified to pursue with classes already formed, subject to the general regulations and discipline of the institution, and to such examinations as may be prescribed in each case. Such students on leaving the institution receiving certificates stating the studies pursued and the attainments made.

Students completing either of the four years' courses receive the degree of Bachelor of Science.

III. TERMS OF ADMISSION.

Applicants for admission to the regular courses of study must be sixteen years of age, and of good moral character, and if coming from other institutions must bring certificates of honorable dismission. They must pass a satisfactory examination in English Grammar and spelling, geography, physical geography, history of the United States, arithmetic, algebra to equations of the second degree, and three books of plane geometry. The regular examinations for admission are held on the Saturday, Monday and Tuesday preceding the annual commencement, and on the day before the opening of the fall term. Candidates for advanced standing are examined in the preparatory studies, and in those already pursued by the class they propose to enter.

IV. STUDENTS AND STUDIES.

The classes now in the institution are :

First—The Senior Class, organized in September, 1870, which will be graduated in June, 1873.

Second—The Sophomore Class, organized in September, 1871, which will be graduated in 1875.

Third—The Freshman Class, organized in September, 1872, which will be graduated in 1876.

The Freshman and Sophomore Classes are pursuing the newly organized four years' course. The Senior Class is the last of the classes under the old three years' course, and there is accordingly, at present, no Junior Class, and there will be no graduating class in 1874.

The Senior Class, now consisting of thirteen students; the Sophomore Class, of seventeen students; and the Freshman Class, of twelve students, making a total of forty-two now in attendance.

There have been in the institution during the year, including the last graduating class, seventy students; of whom two were from Japan, fourteen from the State of New York, one from Connecticut, and the remaining fifty-three from the State of New Jersey, representing the counties as follows :

Atlantic,	1
Bergen,	2
Cumberland,	2
Essex,	4
Gloucester,	1
Hudson,	5
Hunterdon,	1
Mercer,	1
Middlesex,	12
Monmouth,	2
Morris,	6
Ocean,	1
Somerset,	5
Union,	10

A comparison of this statement with those made in former years will show that there has been a steady increase in the number of counties represented in the Scientific School. Seven counties are still unrepresented, however; and it is hoped that the attention of County Superintendents of Schools, and of the friends of education generally, may be called to the importance of having their promising young men avail themselves of the opportunities for obtaining a liberal education which are here gratuitously offered them by the State.

The new course of study, which has now been in operation a little more

than a year, has been carefully arranged, with the design of furnishing what the laws of Congress and of this State evidently contemplated in the establishment of the "College of Agriculture and the Mechanic Arts,"—a liberal as well as a scientific education.

One feature of our system of instruction to which special attention has been called in previous reports, is the large and, we believe, unusual amount of training that students receive in the practical work of the field and laboratory. The excellent results of the system are shown in the fact that our graduates, almost without exception, and with the least possible delay, find ready openings to responsible and remunerative positions in the line of their chosen pursuits. It is a noteworthy fact, also, that a very large proportion of the graduates obtain situations in this State, as engineers, surveyors, architects, chemists, farmers, &c. All of them are using their knowledge, and most of them would not have had their education but for this institution. It seems not too much to say that the College is thus rendering an important and valuable service to the State in return for its comparatively small annual donation to the current expenses.

V. THE LAST GRADUATING CLASS.

At the last commencement of the College, June 21st, 1872, the members of the graduating class were admitted to the degree of Bachelor of Science. Theses were prepared by them and read before the State Board of Visitors on the following subjects:

Edward Fuller Brooks, Greenwich, N. J., "The Bridge over the Schuylkill, Philadelphia."

Joseph Burroughs, Trenton, N. J., "Railroad Construction."

Albert S. Cook, Montville, N. J., "The Inclined Plane; particularly its application to overcoming differences of level on the Morris Canal."

John W. Herbert, Jr., Marlboro, N. J., "The Delaware and Raritan Canal."

William Edward King, Drakeville, N. J., "Our Coal Regions."

George Boardman Ogden, Bridgeton, N. J., "The Catenary as applied to Suspension Bridges."

Frederick James Potter, Rahway, N. J., "The Sewerage System of New Brunswick."

James Fitz Randolph, Morristown, N. J., "Hydraulic Cements."

Charles H. Vannier, Brooklyn, N. Y., "The Steam Engine."

Richard Lovell Williams, Rahway, N. J., "The Bell Bridge, over a tributary of the Delaware River, on the Delaware, Lackawanna and Western Railway."

The two prizes offered by the Professor of Mathematics for the best theses were awarded: the first to Mr. Cook, the second to Mr. Ogden.

The prize of one hundred minerals, offered by the Professor of

Chemistry to the member of the graduating class who should be able to identify and name the largest number of them, was awarded to Mr. Herbert.

VI. AGRICULTURAL DEPARTMENT.

A full report of the condition and operations of this department will be found in the accompanying report of Dr. Cook, the Professor of Agriculture. The experimental farm which the Trustees are required by the laws of the State to carry on in connection with the agricultural department, has been from the first a heavy charge to to the funds of the College. The amount spent in the purchase, equipment and improvement of the farm is already about thirty thousand dollars ($30,000), and owing to its exhausted condition when it came into the possession of the Trustees, it is not yet self-supporting, though becoming each year more nearly so. Even in its present condition, while the system of improvement is yet incomplete, the farm is a striking illustration of the value of scientific processes in the renovation of worn out soils and the increase of agricultural productiveness. In these respects and in the illustration of methods and results of underdraining, rotation of crops, fertilizing, rearing and keeping thoroughbred stock, and the other special or general departments of farming, we believe that it is working out experiments and producing results that are of great interest and value to the agriculturists of this and other States. The number of persons who visit the farm is every year increasing, and the Trustees hope to bring it each season more nearly to the condition of a true model.

It is due to the Professor of Agriculture to say that the success of the operations thus far carried on is to be credited almost wholly to his faithful and judicious management.

The lectures which are required by law to be delivered in the various counties of the State, are being delivered by Dr. Cook at the date of this report, and will be forwarded in time to be printed in connection with it.

VII. IMPROVEMENTS IN BUILDINGS, &c.

The addition of several new departments of study within a few years past, and the steady increase in the number of professors and students, have rendered additional buildings absolutely necessary. This want we are happy to be able to report, is now being rapidly supplied. At the last commencement, the new Geological Hall erected at an expense of more than sixty thousand dollars ($60,000,) was dedicated with interesting and appropriate ceremonies, in which the Governor of New Jersey and many other distinguished gentlemen from this and other States participated. The new hall contains

rooms for a geological museum, for recitations, and working laboratories, and for military drill, and is devoted exclusively to the uses of the scientific and agricultural departments.

The wants of the institution are soon to be still further supplied by the erection of a new chapel and library; work on this building is now rapidly progressing, and it is expected to be ready for dedication at the next commencement. The building will cost fifty thousand dollars (50,000,) and is the gift by will, of Mrs. Sophia Astley Kirkpatrick, widow of the late Hon. Littleton Kirkpatrick, of New Brunswick.

Measures are also in progress for the erection of a dormitory. It is hoped that the necessary fund for this purpose may be raised, and the work be begun at an early day.

In closing this report, the Trustees would say that while they regard with profound satisfaction and gratitude the numerous evidences of the increasing prosperity and usefulness of the institution committed to their trust, they would not for a moment rest satisfied with their present condition, but they hope by a continuance of their present endeavors, to render the College and Scientific School even more alive to the demands of education at the present day, and more worthy of the State, with whose interests and history they are so intimately identified.

The amount received from the State Treasury for the fiscal year ending October 31st, 1872, is six thousand nine hundred and sixty dollars ($6,960,) which has been expended exclusively for the salaries of the professors in the Scientific School.

All which is respectfully submitted,

WM. H. CAMPBELL,

President of the Board of Trustees.

New Brunswick, N. J., Nov. 14, 1872.

APPENDIX.

APPENDIX A.

ON INDIAN CORN AND THE MANURES FOR IT.

Indian corn is the great grain crop of the United States. We raised 760,944,549 bushels in the year 1869. All our wheat, rye, oats, barley and buckwheat together, for the same year was only 626,354,604 bushels, or twenty-four millions less than the corn alone. It is easily and abundantly grown in all the States from Maine to Florida, and from Minnesota to Texas, and California, and grows with poor farming better than any other crop. The population of the United States and Territories in 1870 was 38,977,741, so that almost twenty bushels of corn was raised for each inhabitant. Our wheat crop averaged a little over seven bushels for each person, or somewhat more than a third as much as the corn. The average crop per acre for the whole country in 1870, was estimated at twenty-eight bushels. South Carolina, which was the lowest, averaging 8 9-10 bushels, and Vermont the highest, averaging 39 6-10 bushels. Generally the crop is largest in the middle tier of States, Illinois, Indiana, Missouri, Iowa, Ohio, Kentucky, and Tennessee, which yield in the order they are set down, producing nearly three quarters of the whole crop, and averaging per acre 35 2-10, 39 5-10, 31 4-10, 32, 39, 32 1-10 and 25 8-10 respectively. The average crop of Kansas was reported to be forty-eight bushels in 1869, and is the largest average set down in the published reports as far as I have seen. Our New Jersey average for the same year was thirty-three bushels, and it is usually as little fluctuating as in any of the States.

Much larger crops can be raised. Our agricultural societies report premium crops 100 bushels or more of shelled corn per acre. In Morris county, about 1820, Charles Ford received a premium for raising 132 bushels on an acre. David Petit of Salem county, informs me that he examined a field of forty acres of corn in Elsinboro, in that county, which yielded 100 bushels an acre throughout. I have heard of many other cases, and have no doubt that crops of 100 bushels have been raised, and can be again. In all such reports however, there is an element of uncertainty on account of the great loss in weight and measure in drying. When first husked, corn is wet, heavy, and unfit for use until it has been dried, though measurements for premiums are frequently made when it is in this condition. Some trials show that corn weighed in January had lost

one-fifth, or twenty per cent of its weight, when weighed again the following October, and it is probable that ears will lose full one quarter of their weight between husking time and the following autumn. But after making these allowances the crops mentioned are still far above the average, and show plainly that we ought to raise our average yield far above what it is now.

To help in doing this is well worth the attention of our farmers' clubs, and it is with the hope that some of our members may be able to take an active part in it, that I bring the subject before you to-day.

To raise good crops of corn the ground must be enriched by the application of manures, good varieties of corn must be selected, and the ground and crop thoroughly cultivated. Each of these topics deserves attention; I propose to discuss, mainly the first—that is the enriching of the soil, and will begin with some experiments made at the Agricultural College farm this year, and giving their results.

A plot of ground, about one and a quarter acres, was used for the experiments. It is a rather heavy soil, with many small stones in it, underlaid at the depth of three or four feet by red shale; and the soil is from the disintegrated substance of that rock, mixed with lighter colored sand and gravel. It has been very stubborn and poor, but has been cultivated from year to year, and lightly manured. Last year it had on it a moderate crop of mangold-wurzels, and this spring it was manured evenly and lightly with barnyard manure, plowed and planted with corn. The rows were four feet apart, and the corn was planted in drills, two stalks being finally left every sixteen inches. For convenience in cutting and putting in shocks, six rows together were manured with the same fertilizer, except the thirty-seventh and last row, which was an odd one, and manured alone. It was planted the 19th of May, and the fertilizers put on the surface of the hills of corn the same days.

No. of plot.	Manure per acre in lbs.	Shelled corn per acre. pounds.	uels	Gain per acre. bushels.	Stalks per acre in lbs.
1	250 plaster	5804	82	3	5978
2	Nothing	5505	79		6000
3	500 Superphosphate of lime	5118	73	6 loss	6061
4	250 Muriate of potash	5532	79		7104
5	250 Sulphate of ammonia	5918	85	6	4638
6	375 Am. super. phos. lime	6441	92	13	6057
7	360 Dried blood	7083	101	22	5833

The field was all cultivated in the same way, and the crops of corn and stalks harvested alike, and the grain as well as the stalks weighed.

The corn all started quickly and looked vigorous and thrifty throughout the season. The muriate of potash evidently hurt the growth of that to which it was applied, some of the plants on which it was put, wilted and died within the first two or three weeks. This fertilizer should have been sprinkled along in the drill, or else sown broadcast over the whole ground. The sulphate of ammonia also

caused some injury to the growing corn. Aside from this, I was not able to see any difference in the growth of the stalks, nor was there any decided difference in the time of ripening. The corn was cut up and put in shocks at the end of September, and the last of it was husked on the 31st of October, the stalks weighed the 4th of November. There was no soft or unripened corn. Short ears and nubbins were most abundant on the plots where the crop proves to have been the lightest. The corn was weighed, and seventy pounds allowed for a bushel.

The fertilizers used are such as I judged would be representatives of the three most important and expensive manures, viz., potash, ammonia and phosphoric acid. The *phosphate of lime* was made for me by Russel Coe, of Linden, from bone-black, and contained twelve and six-tenths per cent. soluble phosphoric acid, six and three-tenths per cent. insoluble phosphoric acid, and no ammonia or potash. The *muriate of potash* was bought of John Ralston, 170 Front street, New York, and contained forty-nine per cent- of potash, with no ammonia or phosphoric acid. The *sulphate of ammonia* was also bought of John Ralston, and was almost pure, containing only two or three per cent. of water, and no potash or phosphoric acid; the ammonia in it amounts to twenty-five and four-tenths per cent. The *plaster* is used because the superphosphate of lime always has plaster in it, which is made from the lime in the bones and the sulphuric acid used in the manufacture, and any effect from the superphosphate used might be due to the plaster in it. The *commercial superphosphate* used had the composition given in the following analysis:

ANALYSIS OF STEMFEL'S AMMONIATED DISSOLVED BONE.

	(1.)	(2.)
Soluble phosphoric acid,	6.90	8.27
Insoluble phosphoric acid,	3.77	3.83
Sulphuric acid,	19.55	23.18
Chlorine,	2.17	
Lime,	13.44	
Magnesia,	.36	
Iron and alumina,	.90	
Soda,	3.91	3.99
Insoluble matter,	3.90	
Organic and volatile matter,	20.61	21.53
Water,	23.70	17.32
	99.21	
Ammonia,	2.42	2.61

This was sent from John Ralston & Co., 170 Front street, New York, for trial, and was made at Kalbfleisch's Chemical Works, in

Williamsburg. The second analysis is the one printed on the label of the bag, and was made by Professor S. W. Johnson, of New Haven, from the manufacturers' sample, and they guarantee all of their superphosphate to be equal to this standard. Our specimen, as the comparison shows, is nearly equal to the representation. It is a good fertilizer, and was used in this experiment, to show the effect of an ammoniated phosphate.

The *dried blood* is from the abattoir at Communipaw, and was sent to us by the Manhattan Manufacturing and Fertilizing Company, 166 Front street, New York, and I have no reason to doubt is what it professes to be—blood from the slaughter-house, dried, so as to be convenient for transportation or storage. The manure contained

14.42 per cent. of ammonia,
.70 per cent. of phosphoric acid,
.50 per cent. of potash,
1.00 per cent. of soda.

It is a powerful manure, as appears both from the analysis and from the result of our experiment.

I do not consider the results of our experiments as conclusive. The soil may not have been quite uniform. The corn was a little too thick on the ground—I would prefer having single stocks, ten or twelve inches apart in the rows—the rows, as now, being four feet apart. The experiments with the potash must be varied, using the carbonate (pearlash), or the sulphate, instead of the muriate, and either sowing it broadcast, or, if used in the drill, mixing it with several times its own measure of earth beforehand. The sulphate of ammonia must be changed in its application in the same way—it is probably the best form in which to use ammonia. The experiment with pure super-phosphate of lime is unsatisfactory. I see no reason why the crop from it should not have been as large as that where plaster was used, and the deficiency may be from the soil, or from some oversight or error. The experiment with dried blood accords with the results attributed to that fertilizer; but as it was on the outside row, I do not feel sure that the crop is not larger than it would have been if grown with corn to shade it on both sides.

Still the experiments are suggestive, and will help to guide in the management of others, to be made hereafter.

Very few experiments upon corn have been made. It is not an important crop in those parts of Europe where the principles of agriculture have been most carefully studied, and of course we cannot copy from foreign investigators, as we do so much in regard to crops common to both continents. The only experiments I know of, bearing upon the proper fertilizers for this great staple, were made by Joseph Harris, of Rochester, in 1857, and published in the Transactions of the New York State Agricultural Society for that year, and republished in the Census Report of 1860, in the Introduction of the

volume, on Agriculture. They agree with mine in the grain, but the stalks were not weighed. The high character of Mr. Harris as a farmer, writer, and man of intelligence, leads me to reproduce here the chief part of his valuable paper.

EXPERIMENTS ON INDIAN CORN, BY JOSEPH HARRIS OF ROCHESTER, NEW YORK.

From the Annual Report of the New York State Agricultural Society for 1857 :

I send the results of some experiments with artificial fertilizers on Indian corn. The soil is a light sandy loam, has been under cultivation for upwards of twenty years, and so far as can be ascertained, has never been manured. It has been somewhat impoverished by the growth of cereal crops, and it was thought that for this reason, and on account of its light texture and active character which would cause the manures to act immediately, it was well adapted for the purpose of showing the effect of different manurial substances on the corn crop.

The land was a clover sod, two years old, pastured the previous summer. It was plowed early in the spring, and harrowed till in excellent condition. The corn was planted May 23d, in hills three and a half feet apart each way. Each experiment was made on the 1-10 of an acre. Doubtless it would have been better to have had larger plots, but sufficient land of a similar character could not be got to make the requisite number of experiments on a larger scale. Each experiment consisted of four rows, with one row between without any manure.

The manures were applied in the hill immediately before the seed was planted. With the superphosphate of lime and with plaster (gypsum or sulphate of lime), the seed was placed directly on top of the manure, as it is well known that these manures do not injure the germinating principle of even the smallest seeds. The ashes were dropped in the hill and then covered with soil, and the seed planted on the top so that it should not come in contact with the ashes. Guano and sulphate of ammonia were treated in the same way. On the plots where ashes and guano, or ashes and sulphate of ammonia were both used, the ashes were first put in the hill and covered with soil and guano or sulphate of ammonia placed on the top, and also covered with soil before the seed was planted. The ashes and superphosphate of lime were also treated in the same way. It is well known that unleached ashes, mixed either with guano, sulphate of ammonia or superphosphate mutually decompose each other, setting free the ammonia of the guano and sulphate of ammonia, and converting the soluble phosphate of the super-phosphate of lime into the insoluble form in which it existed before treatment with sulphuric acid. All the plots were planted on the same day, and the manures weighed and applied under my own immediate supervision.

TABLE OF EXPERIMENTS.

The super-phosphate of lime was made on purpose for these experiments, and was a pure mineral manure of superior quality, made from calcined bones, it cost about two and a half cents per pound. The sulphate of ammonia was a good commercial article obtained from London at a cost of about seven cents per pound. The ashes were made from beech and hard maple (acer saccherinum) wood, and were sifted through a fine sieve before being weighed. The guano was the best Peruvian, costing about three cents per pound. It was crushed and sifted before using. In sowing the ashes on plot 1, an error occurred in their application and for the purpose of checking the result, it was deemed advisable to repeat the experiment on plot 10.

On plot 5 with 300 pounds of lime per acre, the plants came up first and exhibited a healthy dark green appearance, which they retained for some time.

Although every precaution, deemed necessary, was taken to prevent the manures from mixing in the hill, or from injuring the seed, yet it was found that those plots dressed with ashes and guano, or with ashes and sulphate of ammonia, were injured to some extent.

It will be seen by examining the table, that, although, the superphosphate of lime had a good effect during the early stages of the growth of the plants, yet the increase of ears of corn in the end, did not come up to these early indications. On plot 5 with 300 pounds of super-phosphate of lime to the acre, the yield is precisely the same as on plot 2 with 100 pounds of plaster (sulphate of lime) per acre. Now, superphosphate of lime is composed necessarily of soluble phosphate of lime and plaster, or sulphate of lime formed from a combination of the sulphuric acid, employed in the manufacture, with the lime of the bones. In the 300 pounds of superphosphate of lime sown on plot 5 there would be about 100 pounds of plaster, and as the effect of this dressing was no greater than was obtained from the 100 pounds of plaster sown on plot 2, it follows that the good effect of the superphosphate was due to the plaster it contained.

Again, on plot 4, with 150 pounds of sulphate of ammonia per acre, we get ninety bushels of ears of sound corn, and fifteen bushels of soft corn (nubbins) per acre, or a total increase over the plot without manure of thirty-eight bushels. Now, the sulphate of ammonia contains no phosphate of lime, and the fact that such a manure gives a considerable increase of crop, confirms the conclusion we have arrived at, from a comparison of the results on plots 2 and 5.

On plot 12 half the quantity of sulphate of ammonia was used as on plot 4, and the increase is a little more than half what it is where double the quantity was used. Again, on plot 13, 200 pounds of Peruvian guano per acre gives nearly as great an increase

of sound corn as the 150 pounds of sulphate of ammonia, and the increase in both cases is evidently due to the ammonia of these manures. The 200 pounds of Peruvian guano contained about fifty pounds of phosphate of lime; but as the sulphate of ammonia, which contains no phosphate of lime, gives as great an increase as the guano, it follows that the phosphate of lime in the guano had little if any effect, a result precisely like that with super phosphate of lime.

We may conclude, therefore, that on this soil, which has never been manured, and which has been cultivated for many years with the *cerealia*, or in other words, with crops which remove a large quantity of phosphate of lime from the soil, the phosphate of lime relatively to the ammonia is not deficient. If such was not the case, an application of soluble phosphate of lime would have given an increase of crop, which we have shown was not the case in any one of the experiments.

Plot 10, with 400 pounds of unleached wood ashes per acre, produces the same quantity of *sound corn*, with an extra bushel of nubbins per acre, as plot 1, without any manure at all; ashes, therefore, applied alone, may be said to have had no effect at all. On plot 3, 400 pounds of ashes and 100 pounds of plaster, give the same total number of bushels per acre as plot 2, with 100 pounds of plaster alone. Plot 8, with 400 pounds of ashes and 150 pounds of sulphate of ammonia, yields three bushels of sound corn and five bushels of nubbins per acre, *less* than plot 4, with 150 pounds of sulphate of ammonia alone. This result may be ascribed to the fact already alluded to, the ashes dissipated some of the ammonia.

Plot 11, with 100 pounds of plaster, 100 pounds of ashes, 300 pounds of super-phosphate of lime, and 200 pounds of Peruvian guano (which contains about as much ammonia as 150 pounds sulphate of ammonia) produced precisely the same number of total bushels per acre as plot 4, with 150 pounds sulphate of ammonia alone, and but four bushels more per acre than plot 13, with 200 pounds of Peruvian guano alone. It is evident from these results that neither ashes nor phosphate had much effect on Indian corn on this impoverished soil. Plot 14 received the largest dressing of ammonia (500 pounds Peruvian guano) and produced much the largest crop, though the increase is not so great in proportion to the guano as where smaller quantities were used.

Similar experiments to those made on Indian corn were made on soil of a similar character, on about an acre of Chinese sugar cane, and the super-phosphate of lime had a very marked effect. This manure was applied in the hill on one plot of the twentieth of an acre, at the rate of 400 pounds an acre, and the plants on this plot came up first and outgrew all the others from the start, and ultimately attained the height of ten feet, while on the plot receiving no manure the plants were not five feet high.

These results seem to indicate that super-phosphate of lime stimulates the growth of stalks and leaves, and has little effect in increasing the production of seed. In raising Indian corn for fodder, or for soiling purposes, super-phosphate of lime may be beneficial, as well as in growing the sorghum for sugar making purposes or for fodder, though perhaps not for seed.

SECOND EXPERIMENT.

In addition to the above, I also made the same season, in an adjoining field, another set of experiments on Indian corn, the results of which I now send.

The land on which these last experiments were made is of a somewhat firmer texture than that on which the others were made. It is situated about a mile from the barn-yard, and on this account has seldom if ever been manured. It has been cultivated for many years with ordinary farm crops. It was plowed early in the spring and harrowed until quite mellow. The corn was planted May 30th, 1857. Each experiment occupied one-tenth of an acre, consisting of four rows, three and a half feet apart, and the same distance between the hills in the rows, with one row unmanured between two experimental plots. The manure was applied in the hills in the same manner as in the first set of experiments.

TABLE OF EXPERIMENTS ON INDIAN CORN AND THEIR RESULTS.

No. of the plots.	Description of manures, and quantities applied per acre.	Bushels of ears sound corn per acre.	Bushels of ears of soft corn per acre.	Total No. of bushels of ears per acre.	Increase per acre of bushels of ears corn.
1	No manure	60	7	67	
2	100 lbs. plaster	70	8	78	11
3	400 lbs. unleached wood ashes, and 100 lbs. plaster, mixed	68	10	78	11
4	150 lbs. sulphate of ammonia	90	15	105	38
5	300 lbs. superphosphate of lime	70	8	78	11
6	150 lbs. sulphate of ammonia and 300 lbs. superphosphate of lime, mixed	85	5	90	23
7	400 lbs. unleached wood ashes (uncertain)	60	12	72	5
8	150 lbs. sulphate ammonia and 400 lbs. unleached wood ashes	87	10	97	30
9	300 lbs. superphosphate of lime, 150 lbs. sulphate ammonia, 400 lbs. unleached wood ashes	100	8	108	41
10	400 lbs. unleached wood ashes	60	8	68	1
11	100 lbs. plaster, 400 lbs. unleached wood ashes, 300 lbs. superphosphate of lime, and 200 lbs. Peruvian guano	95	10	105	38
12	75 lbs. sulphate of ammonia	78	10	88	21
13	200 lbs. Peruvian guano	88	13	101	34
14	100 lbs. unleached wood ashes, 100 lbs. plaster, and 500 lbs. Peruvian guano	111	14	125	58

The barnyard manure was well rotted, and consisted principally of cow-dung, with a little horse-dung. Twenty two-horse wagon loads of this was applied per acre, and each load would probably weigh about one ton. It was put in the hill and covered with soil, and the seed then planted on the top.

RESULTS OF THE EXPERIMENTS.

No. plots.	Quantity and kind of manure per acre.	No. bushels per acre of sound corn.	No bushels per acre of soft corn.	Total bush. per acre.	Increase per acre.
1	No manure.	75	12	87	
2	20 loads barnyard manure.....	82½	10	92½	5½
3	150 lbs. sulphate of ammonia.....	85	30	115	28
4	300 lbs. superphosphate of lime.....	88	10	98	11
5	400 lbs. Peruvian guano.....	90	30	120	33
6	40 lbs. cancerine, or fish manure....	85	20	105	18

On plot 4, three hundred pounds of superphosphate of lime gives a total increase of 11 bushels of ears of corn per acre over the unmanured plot, agreeing exactly with the increase obtained from the same quantity of the same manure on plot 5, in the first set of experiments.

Plot 3, dressed with one hundred and fifty pounds sulphate of ammonia per acre, gives a total increase of 28 bushels of ears of corn per acre over the unmanured plot, and an increase of 22½ ears per acre over plot 2, which received 20 loads of good, well-rotted barnyard dung per acre.

Plot 5, with four hundred pounds Peruvian guano per acre, gives the best crop of this series, viz: an increase of 33 bushels of ears of corn per acre over the unmanured plot, and 27½ over the plot manured with 20 loads of barnyard dung. The four hundred pounds of cancerine (king crabs dried and ground) gives a total increase of 18 bushels of ears per acre over the unmanured plot, and 12½ bushels more than that manured with barnyard dung, though 5 bushels of ears of sound corn and 10 bushels of nubbins per acre less than the same quantity of Peruvian guano.*

JOSEPH HARRIS.

It will be seen that our results corroborate Mr. Harris', and we are thus better satisfied that our experiments are made in the right direction. The product of stalks is additional to his, and is quite as unexpected in regard to the results as was the grain. The plaster and superphosphate have not produced any effect on the weight of the stalks; the ammonia appears to have diminished the weight remarkably, and the potash has increased the weight to a large amount.

* Cancerine contains about two-thirds as much ammonia as good Peruvian guano does.

G. H. C.

It should be remarked that these differences in weight were not observed in the increased size or height of the stalks, or the size of the leaves, and were only found out when the different lots of stalks were weighed. The same thing must be said of the corn itself, the weights of the different results did not all correspond with the measured bushels; this, however, was not discovered till the extra weight of that from the sulphate of ammonia led to fears that some error had been made, and it was then too late to preserve the number of measured bushels of corn on each plot. I am, however, satisfied there was no mistake in weighing.

There was no intention of using these results for determining the profit of each manure, but simply to know their effects. Ammonia can be had more cheaply from clover or barnyard manure, or can be bought to better advantage in Peruvian guano, nitrate of soda fish guano, cancerine, glue-makers waste, hair, &c. Potash can be got in wood ashes, in the potash salts now imported from Germany, in wool-washings, and possibly in the green sand marl of our State. The marl is not usually observed to produce any effect on the growth of corn, but it has been reputed to have a favorable effect on grass, and on potatoes, which in both cases may be ascribed to the potash; and I hope trials by weighing the crops of corn and stalks grown after the application of marl, may be made the coming year, to see if there is any increase in the weight of the stalks from its use. Experiments of this sort when fairly made, will show what manures are needed for the growth of particular crops of roots, grain, grass or vegetables; and the intelligent farmer can, from the varieties of home and foreign manures, provide those which will at the cheapest rate answer his purpose.

Such experiments, too, show that manufacturers of fertilizers have not always deserved the charge which is so often made, that they sell an unfair or fraudulent article. The manures sold may not be adapted for the crop to be grown. The super-phosphate used in our experiments, was made after our own formula and directions, and is, as the analysis shows, an uncommonly good article. We have used it this year on cabbage and turnips, and our crops of both are unusually good; but on the corn it produced no good effect whatever, neither grain nor stalks were any better than those on which no fertilizer was used. So, too, the potash does not prove to have materially increased the amount of corn, but it has added largely to the weight of the stalks. If we had not weighed the stalks we might have said potash was worthless, but now we shall use it again for the same purpose, and shall further try it upon the wheat to see if it will stiffen the straw, and upon timothy grass to see if it will increase the weight.

As the specific effect of manures comes to be better understood by farmers, there will be less buying of mixed fertilizers with the indefinite hope that some of the constituents will benefit their crops,

and they will purchase the simple fertilizers they need, and not waste their profits in paying for and handling those they do not require.

This knowledge will come to farmers partly by study from books, and partly by experiments and observations on the particular soils they cultivate. Every farmers club, and every association of agriculturists can help on this work, and they owe it to themselves and to their honorable and useful occupation to see that it is done.

APPENDIX B.

REPORT OF THE AGRICULTURAL COLLEGE FARM FOR 1872.

The farm is as at the date of the last report. Its area is ninety-nine acres. A single field of five acres is enclosed upon one side of the farm, and there is a lane running from the barn yard to it. The rest of the farm is without any division fences, there being only the boundary fences which enclose it. The small field serves for pasture in the early part of summer, and in the latter part of the season the cattle are tended by a boy when grazing on the stubble fields or on the rowen. By this plan there is a large saving in the cost of fences, there is no waste ground between the different crops, and the appearance is altogether in favor of land not cut up by fences.

Improvements.—During the year ditches to the extent of 1,205 feet have been dug in the new field, at the south end of the farm, 400 feet of old ditch have been dug deeper, and the whole laid with pipe-tile and collars. The ground was not very heavy, but from its extreme flatness, water could escape only after a long time. The subsoil has been found sufficiently open, and with the tile in, and adequate fall, which was secured only by sinking the outlet ditch seven feet deep, the water now drains off freely and completely. The wet grounds are now all drained, and the whole of the land can be plowed and cultivated in any farm crop. The stumps were taken out from the field last drained, and a good crop of corn raised on it this year. There are five acres under-drained and now in pasture from which the stumps have not yet been cleared; but if the winter should be an open one, we hope to finish this, which is the last of the expensive improvements to be made in bringing the whole ground into full use. The drained lands show the benefit of this modern and most valuable improvement in fitting land for thorough and high farming, and we shall be glad to exhibit them to those who need such improvements, and who are yet incredulous as to the profit to be derived from them. The stump-pulling is expensive, but it is absolutely necessary in preparing the ground so that the crops can be raised and gathered with improved and labor-saving implements.

Crops.—Wheat.—Twelve and three-quarter acres, being our last year's oat-field, were in Mediterranean wheat, and the crop was 196 bushels, that is 15 4-10 bushels per acre. The ground was new, having had only two crops of corn and one of oats since it was cleared.

The field was carefully plowed and prepared for the grain, which was sowed broadcast and harrowed in. Two acres were manured with 400 lbs. each of bone dust, two acres with 400 lbs. each of good superphosphate of lime, one and a half acres with a half ton per acre of spoiled oil-cake, and those portions of the rest which were thought to need it with barnyard manure. The wheat started finely, but with the severe and dry winter, and no covering of snow for the young plants, much of the wheat was killed, and we had little if any more than half a crop. The grain was of very fine quality, but the straw unusually short. Our crops suffered in common with most wheat in this part of the State. If it had been drilled, the little ridges might possibly have protected and so preserved it to some extent; except this, I know not what we could have done further to improve it. This year we have drilled in the wheat. Timothy sown immediately after the wheat, was not injured by the winter, and is now looking well. Clover was sown in the spring and came up well, but the drought of the early summer, with the extreme heat of the latter part, has destroyed almost the whole of it.

Two bushels of *Fultz wheat* were received from the Commissioner of Agriculture late in the season. An acre and fifteen hundredths of ground that had been in potatoes, and was thought to be sufficiently manured, was plowed and the grain sowed on it. The soil was not as well prepared as we desired to have it, on account of a storm coming on just as the grain was sown. It came up well, but was much damaged by the winter, and grew unevenly; that which was near the fence and protected by it, was much the best. It ripened as early as the Mediterranean, and yielded twenty and a half bushels, which is eighteen bushels an acre. This is a promising variety of wheat, beardless heads and light-colored straw. The grain is small and plump, thin skinned and light colored. The crop, it will be seen, was a little better than the other. Not being satisfied, however, that the trial is entirely conclusive, a field of two acres has been sown with it this fall, and it is now in a very promising condition.

Indian Corn.—Two fields of corn have been cultivated. One is the experimental field of one and a quarter acres, the cultivation of which is fully described in the annexed paper on Indian corn, in which are all details. The other is a field of sixteen acres, at the extreme south end of the farm. Ten acres of this field were in corn last year, and the other six acres are now in crop for the first time. The ground was all swampy, but is underdrained, and is a sandy loam. It was plowed, manured with a compost of hair from a glue factory, green sand marl and horse-stable manure, three or four loads to the acre. The new ground, from the circumstances of the case, was imperfectly tilled. The corn was planted in hills four feet apart each way, and manured in the hill with a small handful of plaster and hen manure on half, and the hair compost on the other half. The corn grew remarkably well, and the crop from the sixteen acres,

which is now just husked, measures 1668 bushels of ears—an average of 104 bushels an acre. That on the old ground was much the better. The season has been an unusually favorable one for corn in this vicinity. Time of planting, May 16.

Oats.—About eight acres of the last year's corn ground was sown with oats. The seed was sown broadcast and harrowed in on the 17th April. The variety sown was the Surprise, and the crop was 226 bushels, which is at the rate of twenty-eight bushels an acre. The ground was in good condition and well prepared, but dry weather in May and the early part of June, checked the growth and shortened the crop, both of grain and straw, to half the usual average. Oats is a convenient crop to raise between the corn and wheat, but with us it has not proved at all profitable, and we shall seek for some other to take its place in the rotation. Clover seed sown amongst the corn at its last cultivation, would in some cases, furnish the needed substitute, making a hay crop and preparing the ground admirably for the succeeding crop of wheat. But it is liable to be injured, and sometimes all destroyed by summer drought. Potatoes answer the purpose well, where the ground is adapted to their growth, and where the extra labor needed for harvesting and marketing them can be had. Some variety of beans or peas, which would make a good crop for feeding stock, or for market, and one adapted to our climate, would supply a defect in our rotation and add to the productiveness of our farms.

Potatoes.—Seven acres of our best ground was planted with potatoes. The crop secured was only 767 bushels, being 109 bushels an acre. The soil was a sandy loam, in corn last year, plowed in April and planted April 24, in drills thirty inches apart. The seed potatoes were cut in pieces of about two eyes each and planted ten inches apart. They were manured in the drill with a compost of hair, marl, and stable manure, the compost being put on the lightly covered potatoe and covered with earth, about three tons to the acre. The potatoes came up well and were carefully cultivated and kept free of weeds. The vines were small and the crop as given above. It must be counted as a failure; the early drought undoubtedly injured the potatoes, but our soil does not seem adapted to their successful growth. If possible some experiments must be made, by growing them with simple chemical manures, so as to find out what addition to the soil is needed. Early Rose, Early Goodrich, Early Mohawk and Peerless, were the varieties grown.

Hay.—Twenty-five acres have been mown for hay. The crop was much shortened by the damaging effects of last year's drought and the early drought of the present season, and was very light. The clover in particular nearly all died out. It appears difficult to keep our mowing ground permanently in grass; of three plots near the dwelling and which are equally injured by the dying out of the grass, we have plowed up one and sowed it with wheat and timothy,

and the other two we have top-dressed, harrowed and sown with timothy.

Pasture.—Only five acres have been kept for pasture, and our cows are kept up and fed on rye, corn, turnips, beets, and other green crops.

Carrots.—Three acres were planted in carrots, May 22d and 24th; the same ground they were on last year. The crop is 1137 bushels, which is 379 bushels an acre. The seeds did not come up as well as last year, and the season has not been as favorable. The frequent rains in midsummer, and later, favored the growth of weeds to a wonderful degree, and made the cultivation of the carrots expensive; but there is a ready sale for them at fair prices. To grow carrots requires skilful management and cultivation. We shall be more careful to thoroughly enrich and plough the ground, to plant early, and to put in an abundance of seed.

Beets.—Five and three-fourths acres of mangold-wurzels were planted May 27, 28, 29; the most on ground which was in potatoes last year; the rest on turnip ground. The latter has not cost more than half as much labor in the weeding. The crop is 1320 bushels, which is 229 bushels to the acre. The plants were well and evenly set and started vigorously, but a peculiar blight came on the leaves and killed them, so that for some weeks in the summer the beets stood entirely without leaves. Later in the season new leaves grew, but the loss could not be regained and we have not more than one-third the crop the land should have yielded in a favorable season. Mangolds are the best green food we can get for our milk cows in the latter part of winter and in the spring. They keep without difficulty till midsummer. We shall try again with higher manuring, free use of salt, and planting before we plant corn.

Sugar-beets from Silesian sugar-beet seed, sent by the U. S. Commissioner of Agriculture, were raised on eleven rods of ground. The crop is thirty-two bushels which is 465 bushels an acre. The blight came on this variety also, though they were not damaged as much as the mangolds. The sugar-beets are a fair crop, averaging two pounds each, and in form and sweetness are as good as those raised in countries where the beet-sugar manufacture is carried on profitably. And I consider that our experiments last year and this year prove that beets for sugar-making can be successfully grown in New Jersey.

Turnips.—Four acres of ground were planted to ruta-bagas this season. The crop on this plot was 1787 bushels, which is 446 bushels per acre. The soil was a rather heavy loam, that has been in meadow for three years past, and has never been in good condition. It was ploughed after the hay was taken off in the early part of July, harrowed thoroughly with Nishwitz's harrow, and manured broadcast with three two-horse loads per acre of the compost of hair, marl and manure. The seed was drilled in, in ridged rows, about thirty inches apart, and about 400 pounds per acre of pure superphosphate

of lime was put on the rows. The seed was planted July 19th, and eight days after the plants were up, and the third leaf well developed on most of them. They were cultivated and kept clean, produced an enormous growth of leaves, the crop of bulbs was good and of excellent quality. With ground in better condition at the outset, we should undoubtedly have had a much heavier crop.

The blanks in the carrots were so many and large that it was thought best to plant ruta-bagas in them. This was done at the same time the turnip field was planted, and super-phosphate of lime was put in with the seed, just as in the other case. The turnips grew very large, and the tops were so luxuriant as to make more show than the carrots did, and it was feared they would damage that crop, though I think they did not. We gathered 337 bushels of turnips from the carrot field. The turnip crop is a good one with us this year, and we can sell at fair prices.

Cabbage.—Three and a half acres were in cabbages. The ground on which they were grown was partly a heavy loam, part in beets last year, part in rye that was cut for soiling cattle in June, and the remainder in Fultz wheat which was cut in the early part of July. The first and second plots were manured with barnyard manure, and the third with super-phosphate only. The first plot was plowed twice before planting, and showed the good effects of it. The other plots but once—that after wheat being insufficiently manured, was the poorest crop. The season however was favorable, the cabbage worm did us little damage, and we have harvested some 2,000 heads from the whole. It has been a good crop this year.

Sowed Corn.—We have grown this crop on about two acres of ground, sowing it at three different times, May 3d, to July 24th, and it has come forward so that from the time we began cutting it, which was July 1st, we had a good supply for our cows till frost came, and we have two or three tons of dried fodder still. The first plot of three-quarters of an acre came off early enough to be sown again, so that we really had two and three quarter acres of this crop. The ground was heavily manured from the barnyard, and the seed, three bushels to the acre, was mostly sown broad-cast and harrowed in. A small part was put in drills, sixteen inches apart, but no important advantage was perceived from this mode of planting. It all grew well and kept its green color throughout. An enormous quantity of green fodder can be grown in this way, but the ground must be very rich.

Rye.—An acre and a quarter of rye was sown near the barn for early feed for the cows. The ground was good, and was sown early in September. Three bushels of seed were put on an acre. It grew well, covering the ground thickly before winter set in. It began to head-out May 11th, and cutting it for the cows began the 12th of May. It yielded a large amount of green fodder, and lasted till June 20th. It was liked by the cows till almost the last, when it became too hard to be easily chewed. I judged there was more than

twice as much weight of fodder as we could have got from the best crop of grass. All the ground we had in sowed corn is now in rye, sowed at two different times.

Fertilizers.—Barnyard manure must be our reliance for enriching the ground and getting good crops. Every plan that can be devised for profitably increasing the production of this fertilizer is resorted to. A large stock is kept, and all the coarser and more unsaleable products are consumed. Our cattle are stabled and nearly all the manure made is saved. In addition we have purchased a considerable amount of other fertilizers.

There is a large quantity of hair and refuse animal matter accumulating about glue factories. We bought fifty tons of this from Peter Cooper's glue factory in New York and have used it with good results. A compost of fifty tons hair, fifty tons green sand marl and about twenty-five tons stable manure was made in the autumn, and turned and mixed twice during the winter and spring. Fermentation came on with considerable heat, and the hair was much rotted. The compost was applied in this condition. Fermentation developed a powerful stench, and made the heap a nuisance. This year I propose to try it by first picking the hair refuse to pieces in a machine, and applying it directly to the soil without composting.

An analysis of this hair waste was made in our laboratory with the following results :

Water, organic matter, &c.,	73.2
Elements of ammonia,	11.6
Soluble phosphoric acid,	.2
Insoluble phosphoric acid,	3.5
Lime,	7.8
Sulphuric acid,	3.7
	100

Whann's Fertilizer, made at Wilmington, Delaware, is largely used in West Jersey; it is liked by those who have used it. Persons who have visited the extensive manufactory at Wilmington, are satisfied that the fertilizer is honestly prepared. A half ton was sent to the College farm from the stock in store in Philadelphia. It has been used at the rate of 400 pounds the acre on the Fultz wheat, which is now looking remarkably well. The fertilizer has been analyzed in our laboratory, and the following is the

ANALYSIS.

Phosphoric acid, soluble,	3.42
Phosphoric acid, insoluble,	8.99
Potash,	.40
Lime,	15.40

Soda,	3.17
Magnesia,	.47
Iron and alumina,	1.23
Sulphuric acid,	13.90
Chlorine,	3.50
Insoluble matter,	9.30
Organic and combustible matter,	27.33
Water,	13.25
	100.36
Ammonia,	3.40

Grafton Fertilizer.—A barrel of this substance was sent to the farm. It is a white powder or dust and looks like ground marble. It is entirely insoluble in water and must be worthless as a fertilizer, Its composition is as follows:

ANALYSIS.

Lime,	17.19
Magnesia,	9.14
Carbonic acid,	26.33
Phosphoric acid,	0.29
Iron and alumina,	6.21
Insoluble matter,	40.80
	99.96

Other fertilizers used are described in the paper on Indian corn, in this report.

Implements.—Thomas's Smoothing Harrow and Miner's Sub-soil Plow have been added to the implements on the farm.

Stock.—The teams remain as last year. The cows are kept for milk which is sold in town. Ayrshire cows are preferred, and we are gradually filling up our herd with that breed. We have eight cows pure blooded, and one half-blood of the Ayrshires and seven head of common stock. We have also eight Ayrshire heifers. The following table shows the quantity of milk in quarts each cow has given during the year. The quantity given by all the cows is measured every day, and once a fortnight the milk of each cow is measured separately.

Names of cows.	1871. November.	December.	1872. January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	Amount in quarts for the year.	Daily average.	Weight of each cow in pounds.
Belle.....	255	126	93	420	418	420	434	319	372	356	330	179	3713	10.1	1100
Grisette....	255	217	232	84	310	345	341	270	310	279	240	201	3084	8.2	1050
Nelly.....	405	356	387	322	263	240	201		187	294	330	294	3179	8.7	950
Netty.....	337	217	201	161	62			372	310	263	330	310	2563	7.0	946
Mag.....	412	341	332	276	186		248	465	403	341	300	263	3567	9.7	980
Rose	510	380	363	322	341	315	263	210	217	201	180	140	3442	9.4	1145
C.....								330	310	279	240	124	1283	8.5	1180
N. J.	255	201	163	74	356	360	364	300	310	294	270	232	3179	8.7	985
Bergen.....	345	256	328	266	248	240	240	98	434	403	360	279	3497	9.5	1010
Bess.....	332	271	271	203	163	157	77	450	480	388	390	310	3382	9.2	1022
Martin.....	360	326	310	252	264	270	264	180	171	46		372	2765	7.6	1025
Newark ...	405	372	386	287	279	322	264	165	109		465	341	3395	9.2	956
Liese	330	271	248	203	171	217	217	165		326	255	248	2651	7.2	955
Red	352	310	295	252	240	255	294	120	93	62		216	2499	6.9	935
Gebbard...					388	352	372	270	310	279	195	155	2321	9.5	1110

The first six cows are Ayrshire cows; the seventh and eighth are short-horns, and the rest of them common stock. The one named "C" has suckled a calf for several months. Gebbard is a cow bought in March.

DONATIONS.

Fifty tons of marl have been given to the farm by the Squankum and Freehold Marl Company.

Ten hundred weight of Whann's Fertilizer have been received from Walton, Whann & Co., of Philadelphia.

Two hundred pounds of Stemfel's ammoniated dissolved bone, were presented by John Ralston & Co., 170 Front street, New York.

Two hundred pounds of dried blood, sent from the Manhattan Fertilizer Company, of New York.

Burdick's National Hay, Straw and Stalk Cutter, No. 4, a forty dollar machine, furnished to the College Farm by Wm. W. Woodward, of Newton, New Jersey, for fifteen dollars.

The thanks of the Trustees of the Agricultural College, are herein tendered to the liberal and enterprising donors of the above named articles. They aid the farm by enlarging the limited resources at its command; and it is hoped that the donors may be compensated by the patronage of those who become favorably acquainted with them in seeing the good effects and operation of these gifts on our farm.

CONCLUSION.

The results of the year's operations have not been as successful as was hoped for; an unfavorable season has shortened several of our staple crops. But we have had some good crops; our land is much improved, the cost of cultivation is diminished, and we have fairly begun a course of experiments on fertilizers which it is hoped, will add to our knowledge of that subject, and be of service to our farmers and to the State. In succeeding years, we hope to carry forward and enlarge the scope of such experiments. Farmers and those interested in agricultural improvements are invited to visit the farm and inspect its operations and improvements. The Professor of Agriculture will devote Tuesdays to the farm, and would prefer seeing friends on that day; but the foreman is always there and ready to conduct or send strangers about the farm.

NOTE.—THE TABLE OF EXPERIMENTS ON INDIAN CORN AND THEIR RESULTS, on page 20, should have been inserted at the top of page 18.

APPENDIX C.

REPORT OF THE BOARD OF VISITORS.

To His Excellency, Joel Parker, Governor of the State of New Jersey:

The Board of Visitors of the New Jersey State College for Agriculture and Mechanic Arts, beg leave to present their eighth annual report, as required by law:

In accordance with the provisions of the law under which it is organized, this Board has held two meetings at the College buildings in New Brunswick, and has made an examination into its condition. The first of these meetings was held December 20, 1871, and the second, June 14, 1872. At each of these they attended the examinations of the several classes by their professors; and received from the president and professors detailed reports of the subjects which had been pursued, and the progress made in each. These subjects for the year have been as follows:

SENIOR CLASS,

with President Campbell, in Moral Philosophy; with Professor Cook, in Chemistry and Physics; with Professor Atherton, in International Law; with Professor Bowser, in Engineering and Mechanics; with Professor Meyer, in German.

JUNIOR CLASS,

with Professor Atherton, in Constitutional Law; with Professor Bowser, in Analytical and Descriptive Geometry; with Professor Van Dyck, in Chemistry; with Professor Doolittle, in Mental Philosophy; with Professor Bowser, in Railroad Curves; with Professor Meyer, in German.

SOPHOMORE CLASS,

with Professor Murray, in Surveying; with Professor Bowser, in Descriptive Geometry; with Professor Atherton, in History; with Professor Van Dyck, in Chemistry.

FRESHMAN CLASS,

with Professor Doolittle, in Rhetoric and English Literature; with Professor Van Dyck, in Physiology and Zoology; with Professor Meyer, in French; with Tutor Hasbrouck, in Algebra, Geometry, and Trigonometry.

From their observation of the thoroughness and fairness of the examinations, and the mastery which the classes showed on the subjects studied, the Board formed a favorable conclusion in regard to the character of the education imparted in the institution. The object to be attained by this College as far as it is a State institution and subject to its supervision, seems to be to provide an education in practical science, or in science as applied to the practical industries of the State. Such are the evident design and intent of the act of Congress under which the State Colleges for Agriculture and the Mechanic Arts have been established. And this intent is kept steadily in view in the course of study which has been adopted in this College. There are two distinct courses of study in the institution, termed respectively, the Course in Engineering and Mechanics, and the Course in Chemistry and Agriculture. In the first of these the instruction consists mainly but not exclusively of mathematics and its applications to the occupations of the civil and mechanical engineer, the land surveyor or the architect. Other sciences are so far included, as they contribute more or less to equip the engineer for his work. In the latter course, the requirements of the manufacturer, the chemist, the metallurgist, the miner, or the scientific farmer, are kept more especially in view. In both the sciences taught, and the manner and scope with which they are taught, are so far as practicable, adapted to the future applications they are to receive in the professions and occupations of the students. In addition to these directly useful and practical branches, the students are trained in what more commonly constitutes a liberal education. Moral and intellectual philosophy, history and rhetoric, constitutional and international law, are included in the curriculum as being essential to the education of every intelligent citizen. So also, German and French are taught, in order that the works in those languages, which so often are required in their professions, may be available to them. In the opinion of the Board this combination of studies, giving the students not only a practical education but also a liberal culture, is greatly to be commended.

The Board also desire to report with their expression of marked approval the very generous provision which the Board of Trustees have made for the equipment of this department of the College, and the liberal spirit in which the State pupils are treated by them. The State is entitled, in accordance with the contract with the Board of Trustees of Rutgers College, to claim free education for forty pupils, distributed among the counties in proportion to their population. The quota of many counties is not filled, while in respect to others,

more apply for State scholarships than their quota will allow. It has been the liberal and praiseworthy practice of the President and Board of Trustees when there were needy and deserving young men, to place them upon the unoccupied scholarships of other counties; reserving the privilege for those counties to re-occupy their own scholarships whenever they had candidates for them. In this way a considerable number of promising and talented young men have been enabled to enjoy the benefits of the school who otherwise would be unable to do so.

The Board also take great satisfaction in reporting the extensive additions which have been recently made or are now being made to the permanent equipment of the College. At the recent celebration of the 100th anniversary of Rutgers College, and in connection with that event, a very gratifying addition was made to the funds of the College by its Alumni, and friends. The whole of this sum, amounting in the aggregate to about $113,000, has, by the Trustees, been set apart and employed for the benefit of the Scientific Department. Two professorships have been permanently endowed, viz: the professorship of Analytical Chemistry, and the professorship of Mining and Metallurgy. The remainder of the sum has been used for the erection of the new Geological Hall. At the request of the President the Board inspected this building at their meeting in June.

The building is 120 by 45 feet, built of Connecticut freestone. The *basement story* contains the following rooms, viz: the armory 80 by 40 feet to be used for drilling the students in military exercises; a small room for the safe keeping of the arms and accoutrements issued to the institution by the adjutant-general; and rooms for the assaying of minerals, etc.

The *first story* contains an office 20 by 20 feet; a large chemical lecture-room, 35 feet by 40, designed for lectures on general chemistry and physics, and also designed to be used when occasion requires for public lectures on scientific subjects; an analytical labratory 30 by 40 feet for the use of students in analytical chemistry; a professor's labratory, a small lecture-room, a balance room, and closets for storing chemicals, etc.

The *second story* contains a lecture room twenty by thirty feet, for the Professor of Mining and Metallurgy, and a large hall forty by ninety feet, with a gallery on four sides, to be used for a general museum containing the collections in geology, paleontology, mineralogy, &c. This hall is to be fitted up with cases on each side under the galleries, and in the galleries, and with table cases along the central portion.

The *third story* contains a curator's room, twenty by thirty feet, to be used for arranging, assorting and labelling the specimens. It is connected with the gallery of the museum.

The whole building is heated by steam, and is supplied throughout with both gas and water. An elevator for raising boxes, specimens, &c., runs from the basement to the top. The staircase is very com-

modious and is made of black walnut newels and railings, and sides of yellow pine cut in scroll patterns. The building is very complete, and is admirably arranged. It will supply the accommodations for the purposes intended for many years to come.

At their semi-annual meeting in June, the Board besides attending the usual examinations of the classes, also attended the reading of the theses of the graduating class. Each member of the class is required to prepare and present previous to receiving his diploma, a thesis or essay on some scientific subject, illustrative of his studies. In many cases these theses are valuable scientific treatises, accompanied when necessary with elaborate, original drawings, and with exact mathematical calculations. The design of this requirement is to stimulate the young men to make independent and original investigations, and thus to call into use the learning they have acquired, and to give them confidence in their own abilities. Many of the practical problems with which they will have to deal in their future professional careers, are in this way wrought out by them under the direction and with the encouragement of the professor. For several years past the professor of mathematics has offered a prize in books for the best and second best thesis; and the professor of chemistry has offered a prize consisting of a little cabinet of one hundred minerals, to the student of the graduating class who shall, within a given time correctly name the greatest number of them. The theses of the graduating class to which the board listened were as follows:

Edward F. Brooks, Greenwich, N. J., "The Jones' Truss in a Philadelphia Bridge."

Joseph Burroughs, Trenton, N. J., "Railroad Construction."

Albert S. Cook, Montville, N. J., "The Inclined Plane in the Morris Canal."

John W. Herbert, Jr., Marlboro, N. J., "The Delaware and Raritan Canal."

William E. King, Drakeville, N. J., "The Wyoming Coal Fields."

George B. Ogden, Bridgeton, N. J., "The Catenary and its application to Suspension Bridges."

Frederick James Potter, Rahway, N. J., "The Sewerage of New Brunswick."

James Fitz Randolph, Morristown, N. J., "Hydraulic Limes and Cements."

Charles H. Vannier, Brooklyn, N. Y., "The Steam Engine."

Richard L. Williams, Rahway, N. J., "Bell's Bridge."

The prize for the best thesis was awarded to Albert S. Cook. It was well deserving of this distinction, although several others closely approximated it in excellence. It gave a very clear and minute account of the construction of the planes used for elevating the boats of the Morris canal, and explained and illustrated very satisfactorily their relative advantages and disadvantages as compared with the lock. The second prize was awarded to George B. Ogden for his thesis on the catenary as applied to suspension bridges. It was ac-

companied with full mathematical calculations of the strain at different points, and was in all a very creditable production.

The prize in mineralogy was, after an animated contest, awarded to John W. Herbert, Jr.

A copy of the law passed at the last session of the legislature and approved April 4, 1872, entitled an act to organize and establish a State Board of Agriculture, was laid before this board and considered by them. In accordance with its provisions the board proceeded to designate three of their number who shall be members of the said board of agriculture, viz:

Hon. William H. Hendrickson, from Monmouth County.

Hon. James Bishop of Middlesex County.

Hon. Joseph Thompson of Hunterdon County.

The above persons were authorized to decide by lot as required by law their terms of office, whether for one, two, or three years.

The Board beg leave to notify your Excellency that the terms of office of the following members of this board will expire on the 12th day of April, and to ask you to make appointments to fill said vacancies.

In the First Congressional District, James M. Mecum, Esq., of Salem.

In the Second Congressional District, Hon. William H. Hendrickson, of Middletown.

Also that in the Third Congressional District, Hon. James Bishop, on account of an anticipated prolonged absence from the country, has resigned his place in this board; his term expiring April 12, 1876.

All of which is respectfully submitted.

WM. H. HENDRICKSON, *President.*

WILLIAM PARRY, *Secretary.*